GEWEX Radiative Flux Assessment (RFA) Update

Presenter: Takmeng Wong (NASA LaRC)

Oversite Committee: Atsumu Ohmura (ETH), Ehrhard Raschke (U. of Hamburg), William Rossow (NASA GISS), Paul Stackhouse (NASA LaRC) and Bruce Wielicki (NASA LaRC)

~75 assessment participants (TOA, surface, and both)

Local Contributors: Lin Chambers (LaRC), Takmeng Wong (LaRC), Laura Hinkelman (NIA), J. Colleen Mikovitz (AS&M), Taiping Zhang, Danny Mangosing, Yan Chen (SAIC), Juliet Pao, Walter Baskin, Churngwei Chu, Sherry King, Penny Oots, Nancy Ritchey, Tomeka Watkinson and others (ASDC)

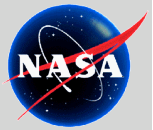
CERES Science Team Meeting

Victoria, B.C., Canada

14-16 November, 2007

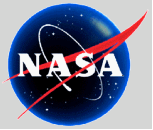
Radiative Flux Assessment Overview

- **Purposes:**
  - **Assess our current understanding and capability to**
    - ***derive TOA and surface radiative fluxes from analysis of satellite observations***
    - ***validate these fluxes with surface observations***
    - ***simulate these fluxes with models and assimilation***
  - **Assess uncertainties and outstanding issues in flux estimation, particularly long-term variability**
    - ***sources include satellite calibration, input data sources, and assumptions (particularly in regards to spatial and temporal gap filling)***
    - ***Compare surface fluxes to surface based measurements***
    - ***intercompare existing data products***
    - ***identify largest uncertainties and needs***
  - **Report methods and uncertainties to be useful for future IPCC reports on long-term data uncertainty.**
  - **Develop climate system observation requirements for radiative fluxes and compare to current product accuracies.**
  - **Assess GCM products.**



GEWEX RFA Activities to Date

- 1st Workshop held (Oct. 2004 - Zurich, Switzerland)
  - Discussed issues
  - Developed pieces of draft document
  - Assigned TOA and surface groups
- Draft Document Outline
  - Proposed intercomparison activities
- 2nd Workshop held (Feb. 2006 - Williamsburg, VA)
  - Refined document outline
  - Defined surface/TOA actions and goals
  - Assigning authors
- Web Site (Rel. 1.2) Now Operational
  - Includes document framework
  - Provides for ingest and download of all data sets
  - Many data sets ingested and ready for further analysis
- 3rd Workshop held (June 2007 - New York City, NY)
  - Results discussed
  - Preliminary conclusions discussed relevant to document
  - Deadlines set for draft documents

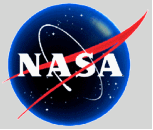


GEWEX-RFA Data Archive

To date, data have been submitted from:

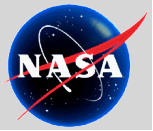
- ASRB
- BSRN
- CAVE
- CERES (ERBE-like, and SRBAVG)
- DLR ISIS
- ERBE (ERBES)
- GFDL CM 2.1
- HIRS IR (OLR only)
- ISCCP-FD
- ScaRaB
- NASA/GEWEX SRB
- U. Maryland SRB (Z. Li and R. Pinker)
- U. Oregon Surface Sites (>20 years)

Also non-standard surface data from Chuck Long.



GEWEX-RFA Results To Date

- Smith et al., 2006: ERB calibration intercomparison
- Raschke et al., 2006, GRL: SRB, ISCCP TOA comparison
- Zhang et al., 2006a,b: Near-surface meteorological and radiative properties
- Wong et al, 2006 => ERBE, HIRS, ISSCP-FD time series
- Loeb et al. (JClim, 2007): CERES/Terra vs. ISCCP-FD, CERES/Terra vs. SeaWiFS PAR, and CERES/Terra vs. CERES/Aqua.
- SRB/CERES/ISCCP teams: Various intercomparisons
- Roesch et al. (not published): Sensitivity of monthly averages to treatment of data gaps
- Hinkelman et al. (not published): Preliminary time series analysis
- Freidenreich: GFDL model results vs. ISCCP-FD
- Schaaf: Surface albedo studies



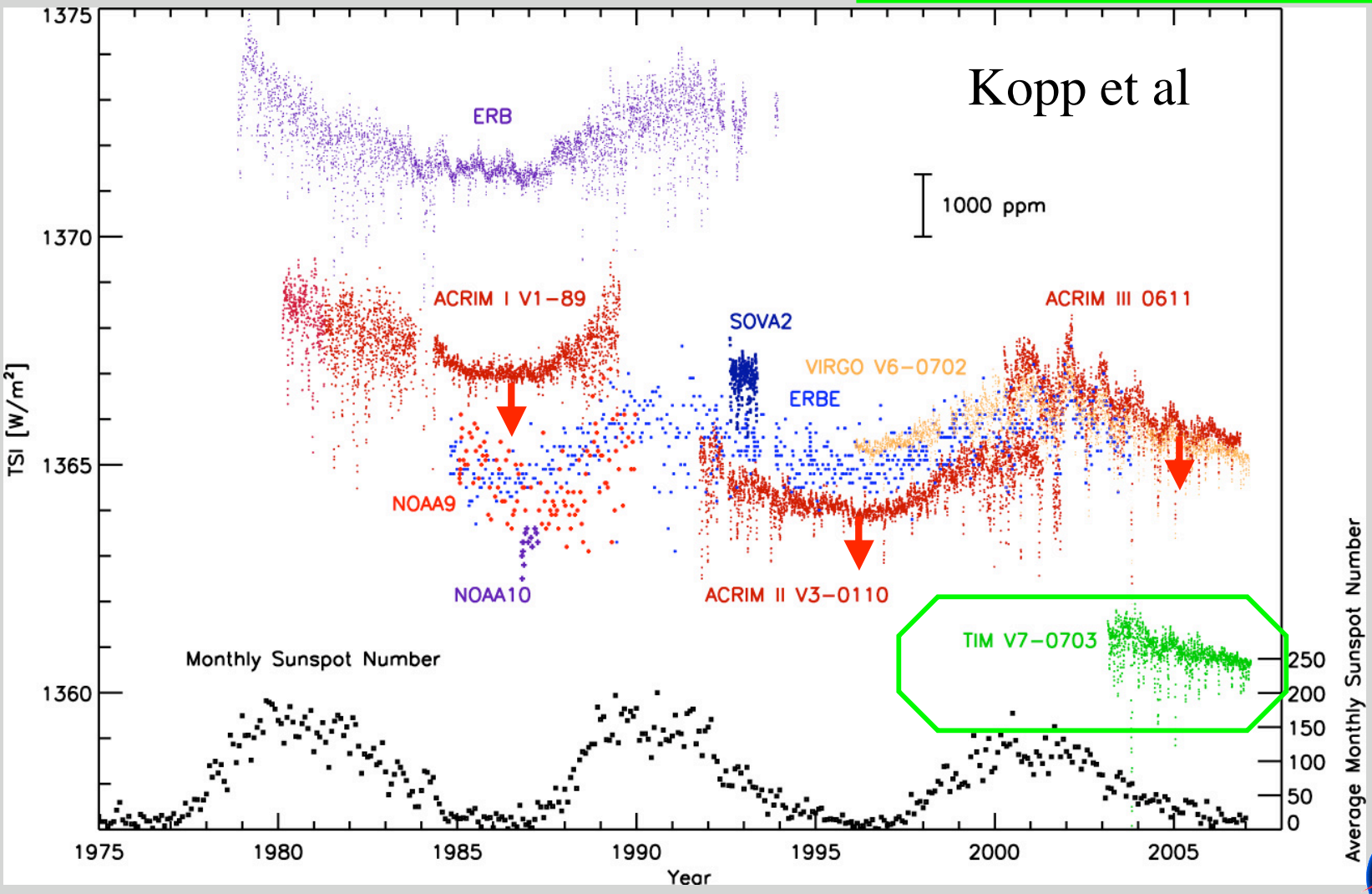
Workshop 3: June 25-27, 2007

-About 30 participants
-New results/analysis presented
-Remaining analysis assignments more clearly defined and focused
-Strawman conclusions discussed
-Deadlines set

Radiative Flux: SORCE TIM Indicates Lower TSI Value

New discovery that the TSI is ~1361 W/m², not 1366 W/m² (TIM).

SORCE/TIM result motivated detailed examination by NIST and TSI community.

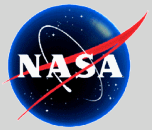


Dutton and Long

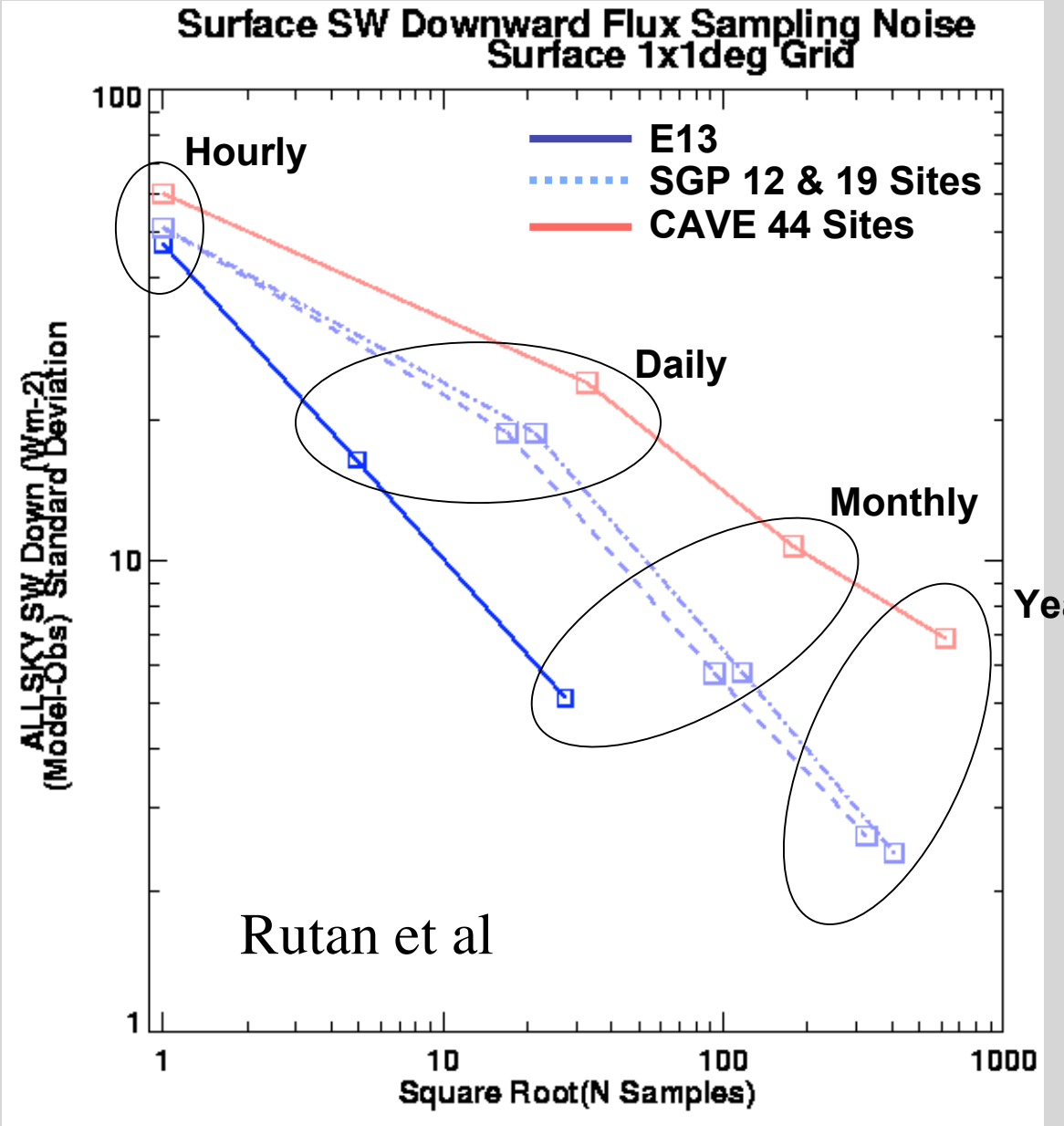
Operational Comparison

	Best	Typical	Worst
Diffuse SW	4.0 ± 1.4	8.9 ± 2.9	11.8 ± 3.7
Direct Normal SW	6.2 ± 3.2	13.6 ± 6.4	15.0 ± 6.8
Downwelling LW	3.3 ± 0.7	5.6 ± 1.4	7.7 ± 2.2
Downwelling SW	9.2 ± 4.0	16.1 ± 7.5	17.5 ± 7.2
Upwelling SW	11.1 ± 2.8		
Upwelling LW	9.6 ± 3.0		

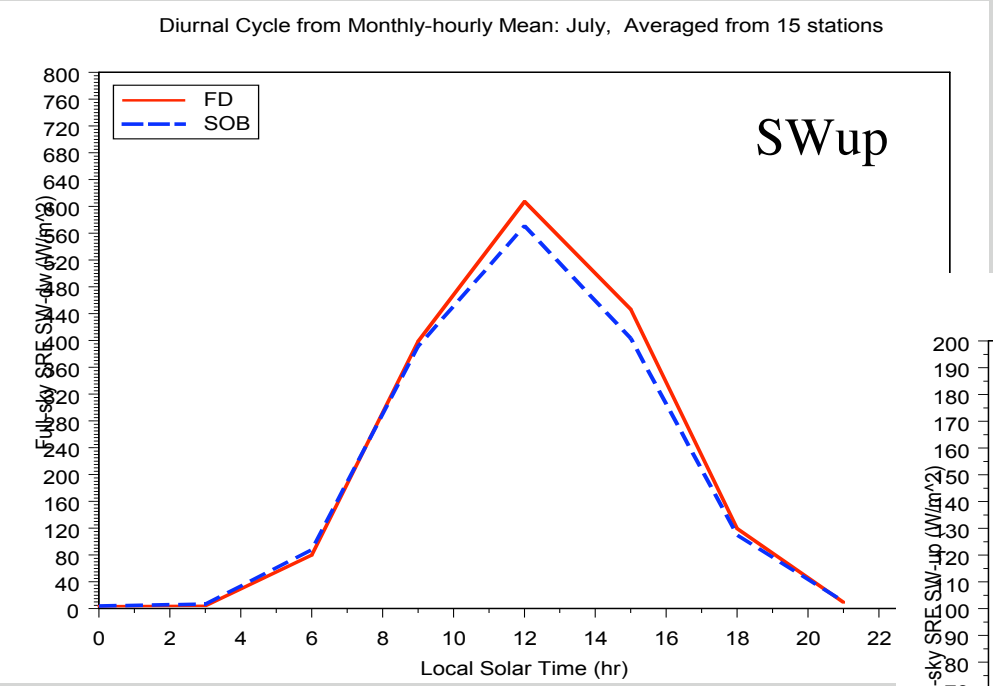
From "Best Estimate Radiation Flux Value-Added Product: Algorithm Operational Details and Explanations", Shi and Long (2002), ARM Tech Report ARM-TR-008

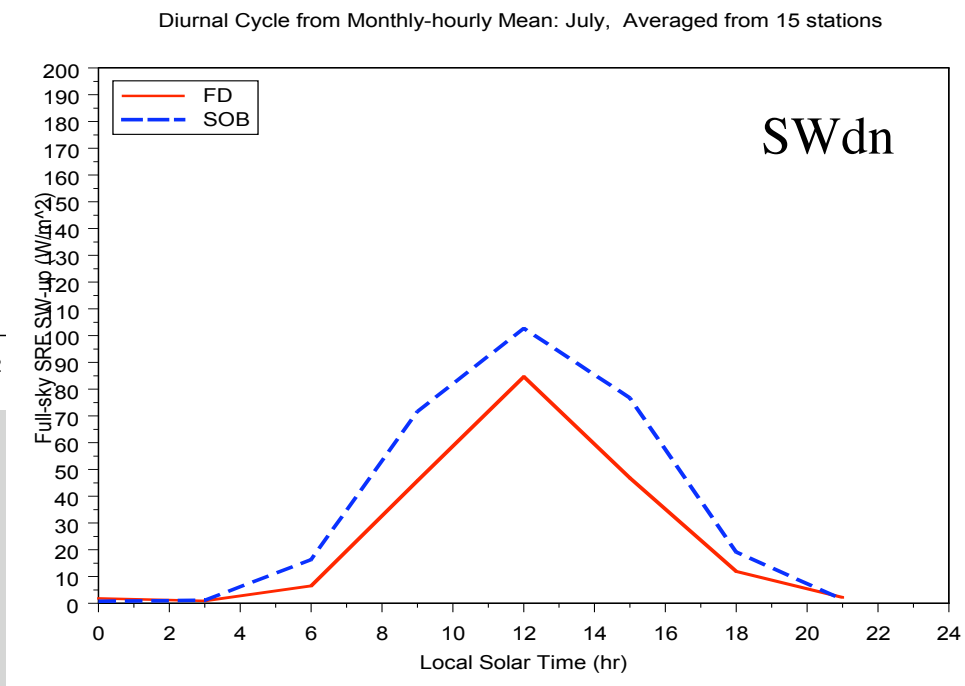


SW Down: Noise from Multiple Sites



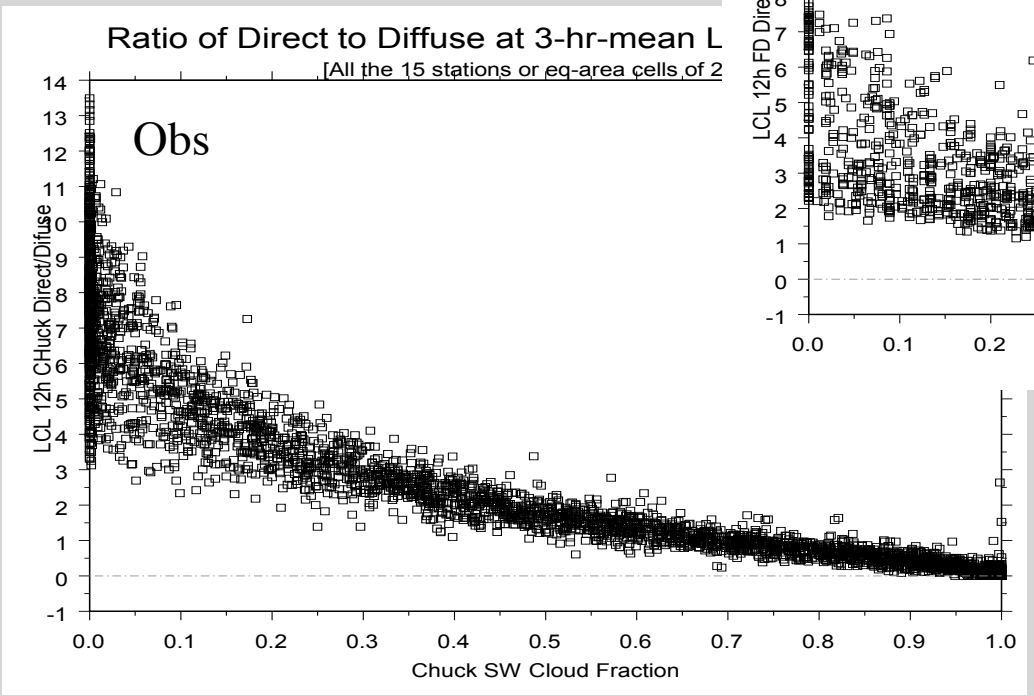
Full-sky Surface Radiation Diurnal Cycle Comparison: FD vs Observations

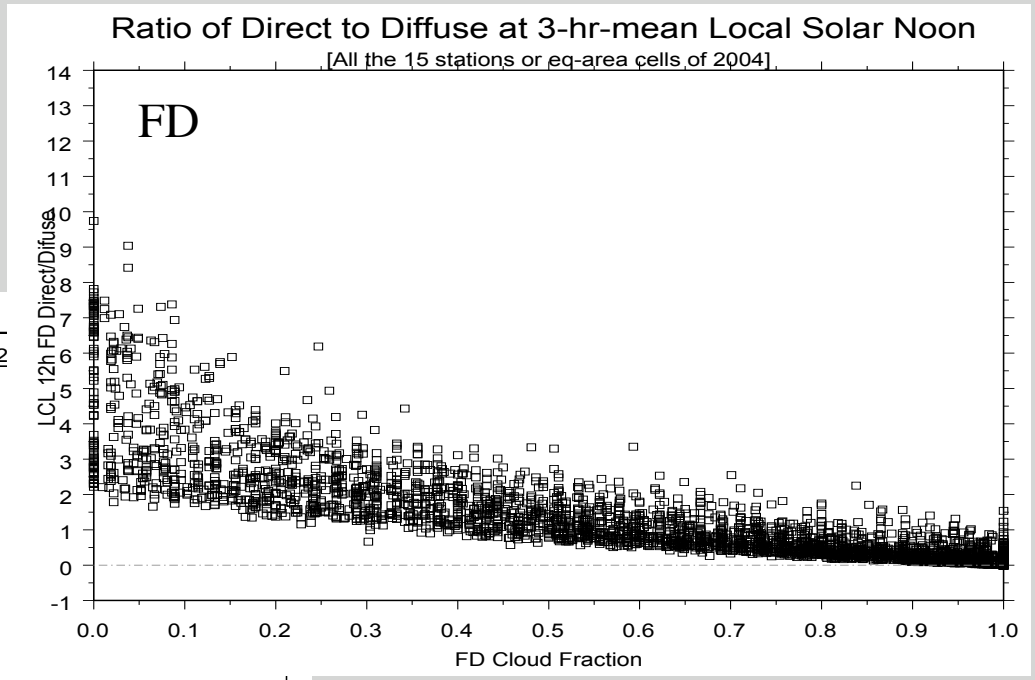




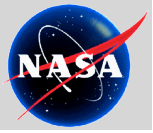
Zhang et al

Cloud Fraction vs Direct/Diffuse Ratio : OBS [(SW derived) From 15 BEST Stations Selected from BSRN, ARM and SURFRAD] vs. FD (Cell-mean over the same locations)

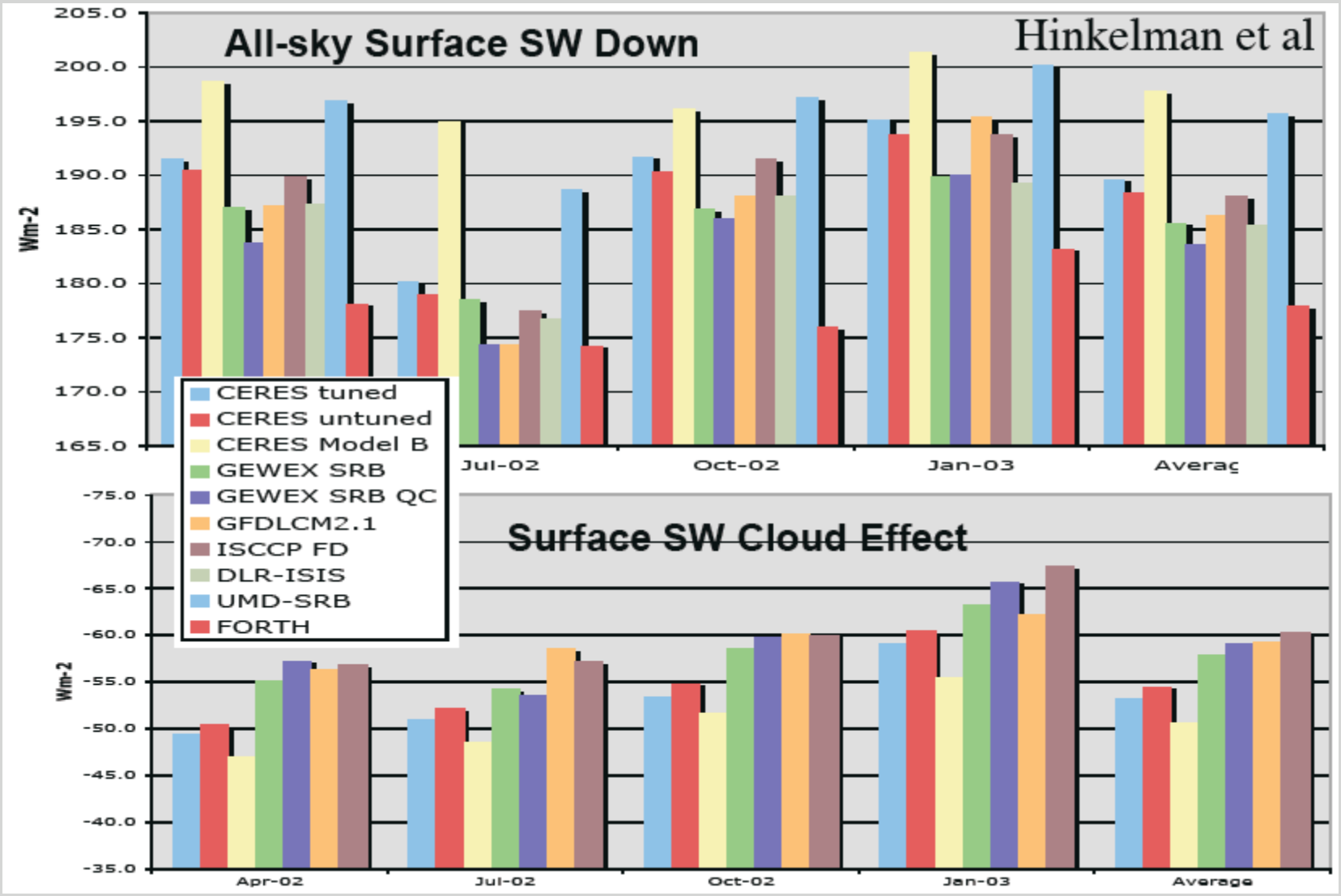




Zhang et al



Multi-data Set Comparisons



Surface Radiation Budget Results

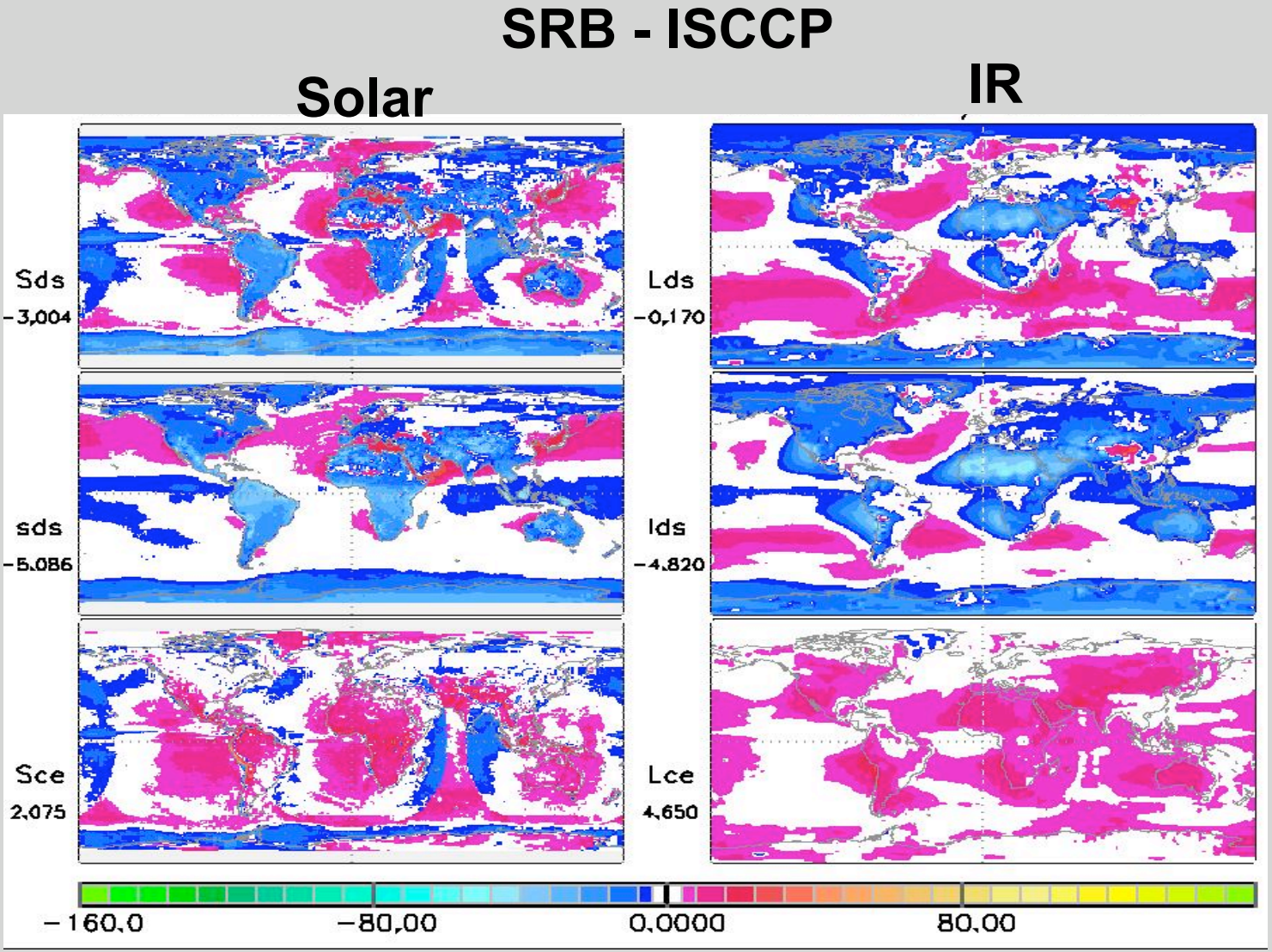
	K&T	Mean
SW Down:	198	178 – 198
SW Up:	30	21 – 24
SW CRF	–	-60 – -51
LW Down:	324	341 – 346
LW Up:	390	392 – 399
LW CRF	46	25 – 36
SW albedo	0.15	0.11 – 0.125

Hinkelman et al

Kinne et al

SRB, ISCCP Comparisons

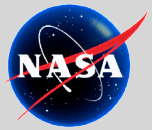
- down all-sky
- down clr-sky
- cloud-effect down



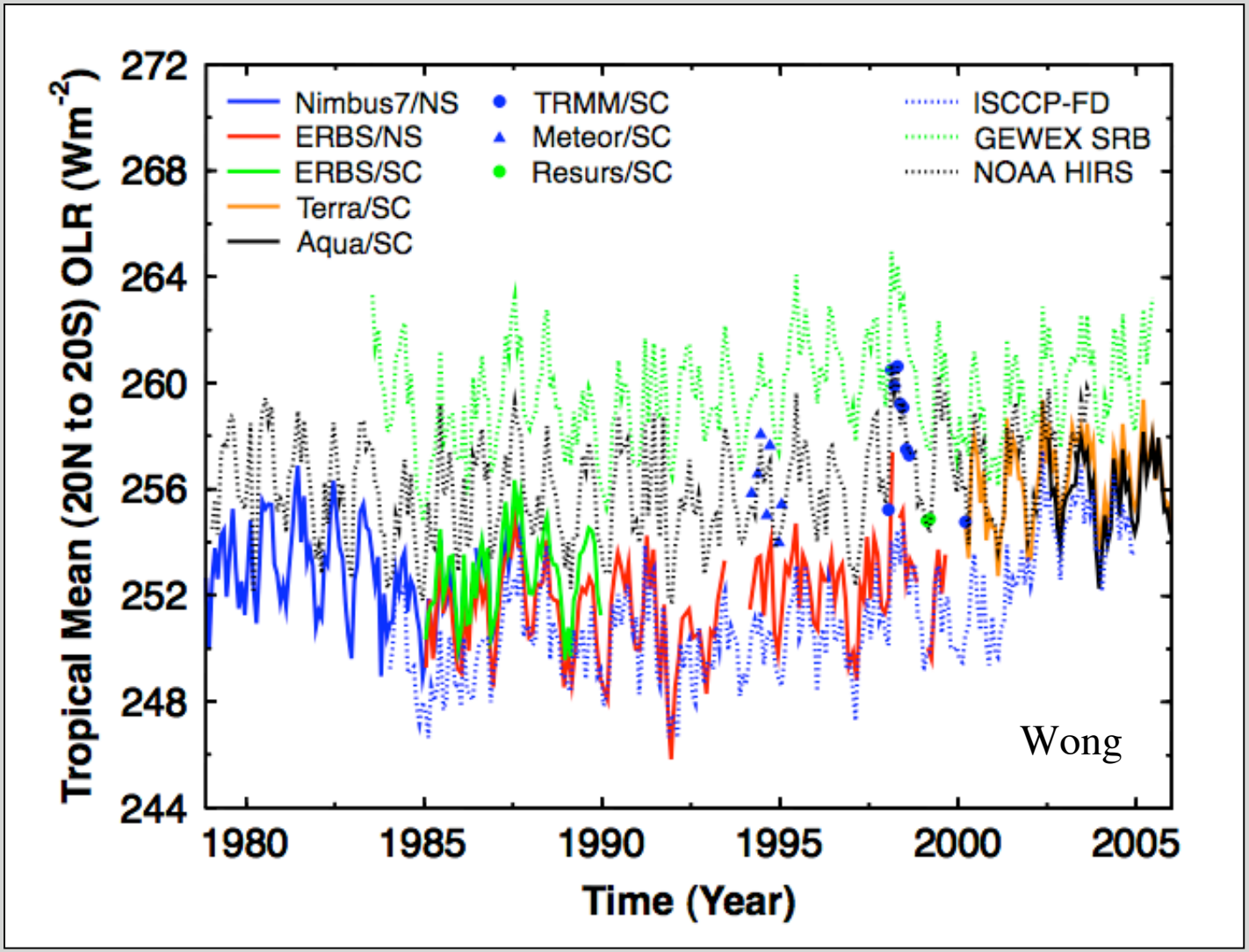
- SRB sol CE is less neg than ISCCP by 2W/m2 (opt. thinner clds)
- SRB IR CE is larger than ISCCP by 5W/m2 (lower altitude clds)

Kinne et al Summary

- differences in SRB-ISCCP surface dn flux products are smaller in solar than IR
  - *alt. positioning and microphysics seem inconsist.*
- SRB-ISCCP CE differences are smaller than potential uncertainties introduced by cloud climatology differences / implementations
- IPCC CE differences from 20 different global model are ~ 3 times larger than the climatology / implementation differences



Tropical OLR Intercomparisons



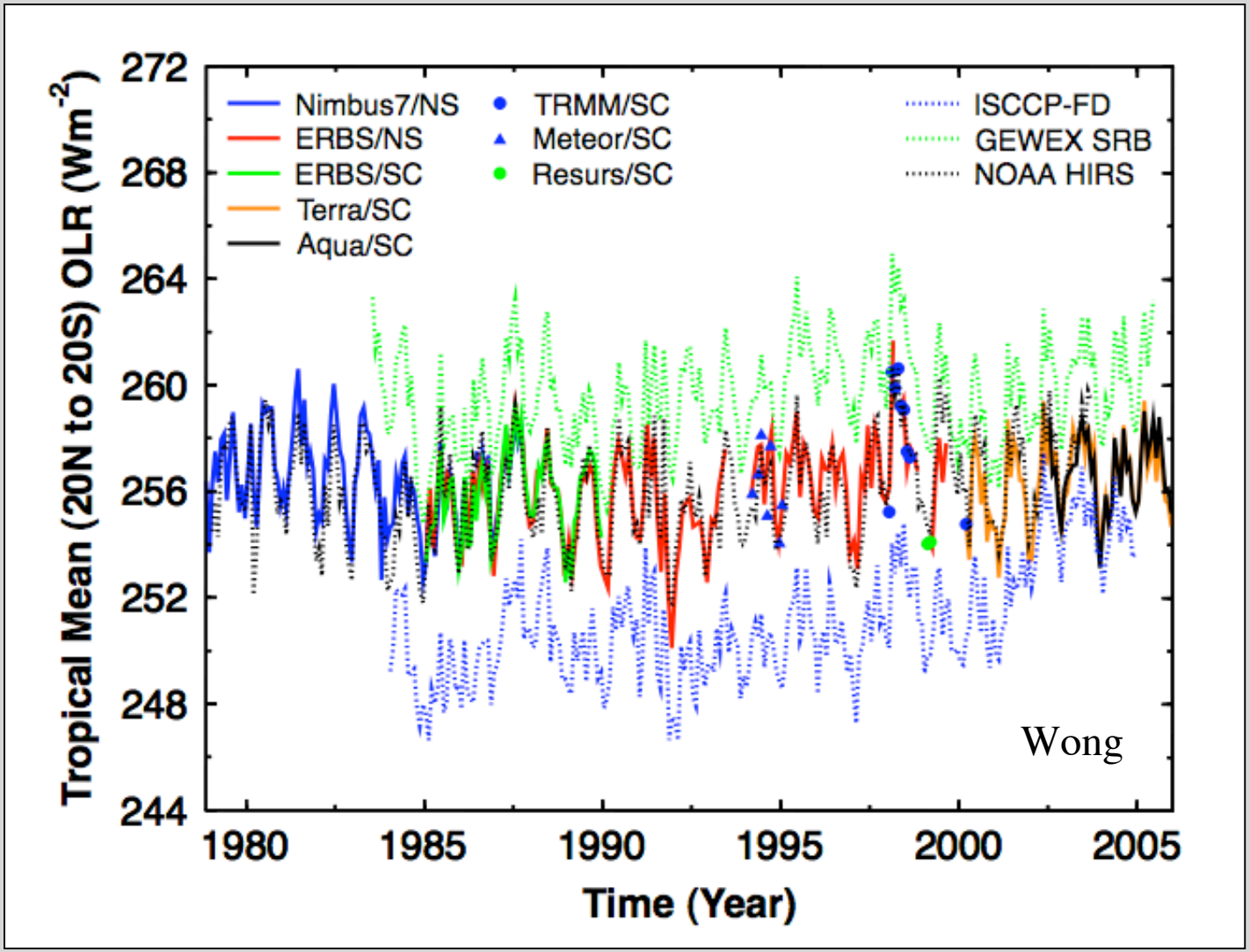
Anthropogenic radiative forcing of climate is ~ 0.6 Wm^{-2} per decade

Goal ~ 0.15 Wm^{-2} per decade

1.2 Wm^{-2} calibration accuracy: current best capability (e.g. CERES)

Current spread 5 - 10 Wm^{-2}; Narrows After 2001

Tropical OLR with Broadband Overlap Adjustment

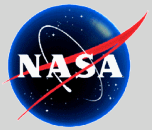


Proposed adjustment uses overlap points from TRMM/Terra/Resurs, TRMM/ERBS-NS, ERBS-NS/SC, and Nimbus7-NS/ERBS

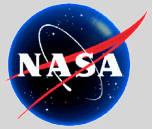
Total change to ERBS/Nimbus nearly 5 W m^{-2}

Radiative Flux Assessment Next Steps

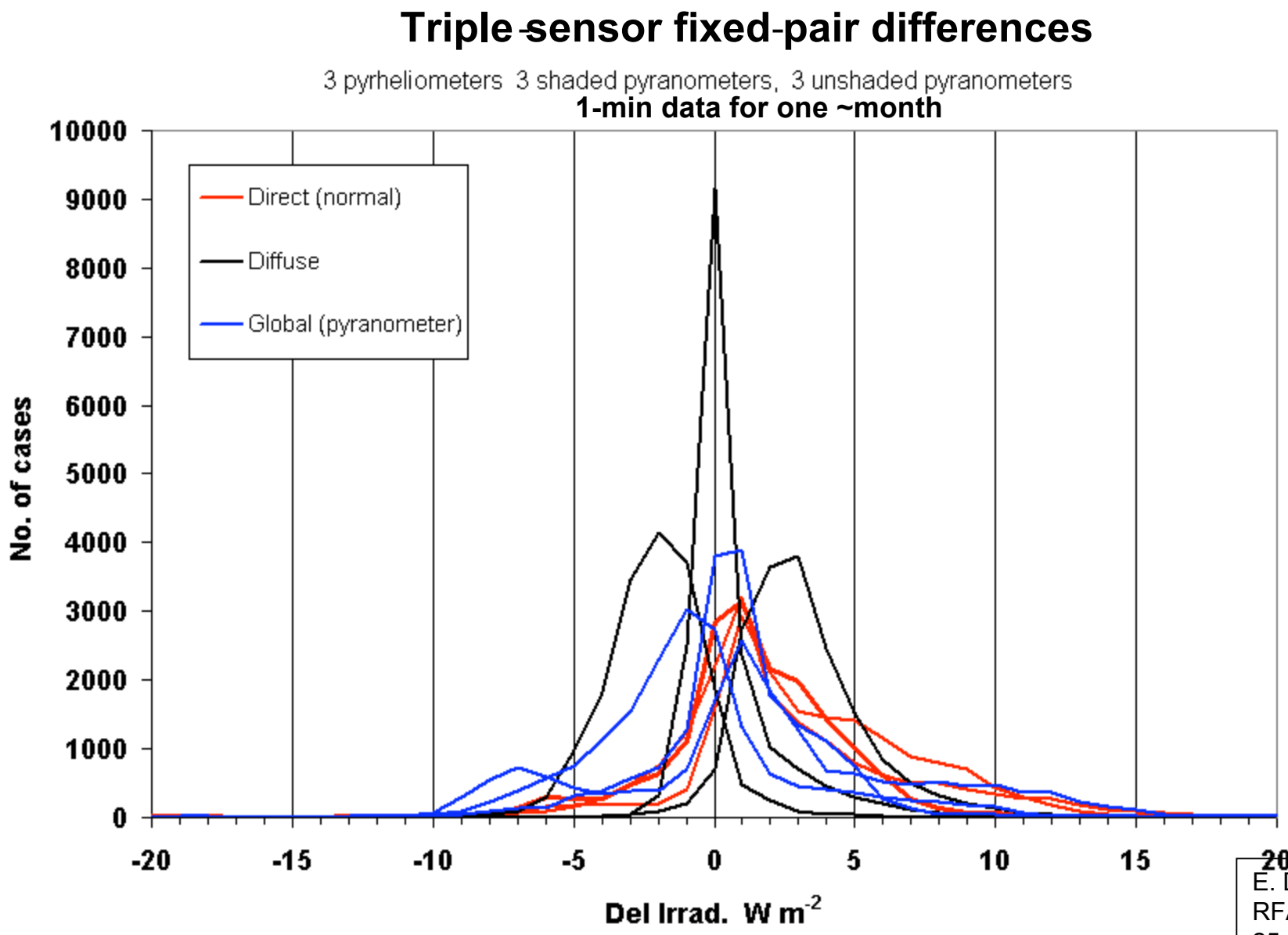
- Data ingest and analysis
  - Continue submittal of data products from participants (particularly additional long-term surface site data - Oct. 1, 2007 => done)
  - Continue evaluation of ingested datasets against surface site data; cross comparisons; different time and space scales
  - Collection, posting, discussion of analysis results
- Assembly of Radiative Flux Assessment Draft
  - Solicit participant results and analysis for posting
  - Exchange information via news group
  - Chapter leads selected; coordinate analysis; assemble chapters with submitted results
- Collaborative draft assessment document (Jan. 2, 2008)
- Final document (to follow)



Backup

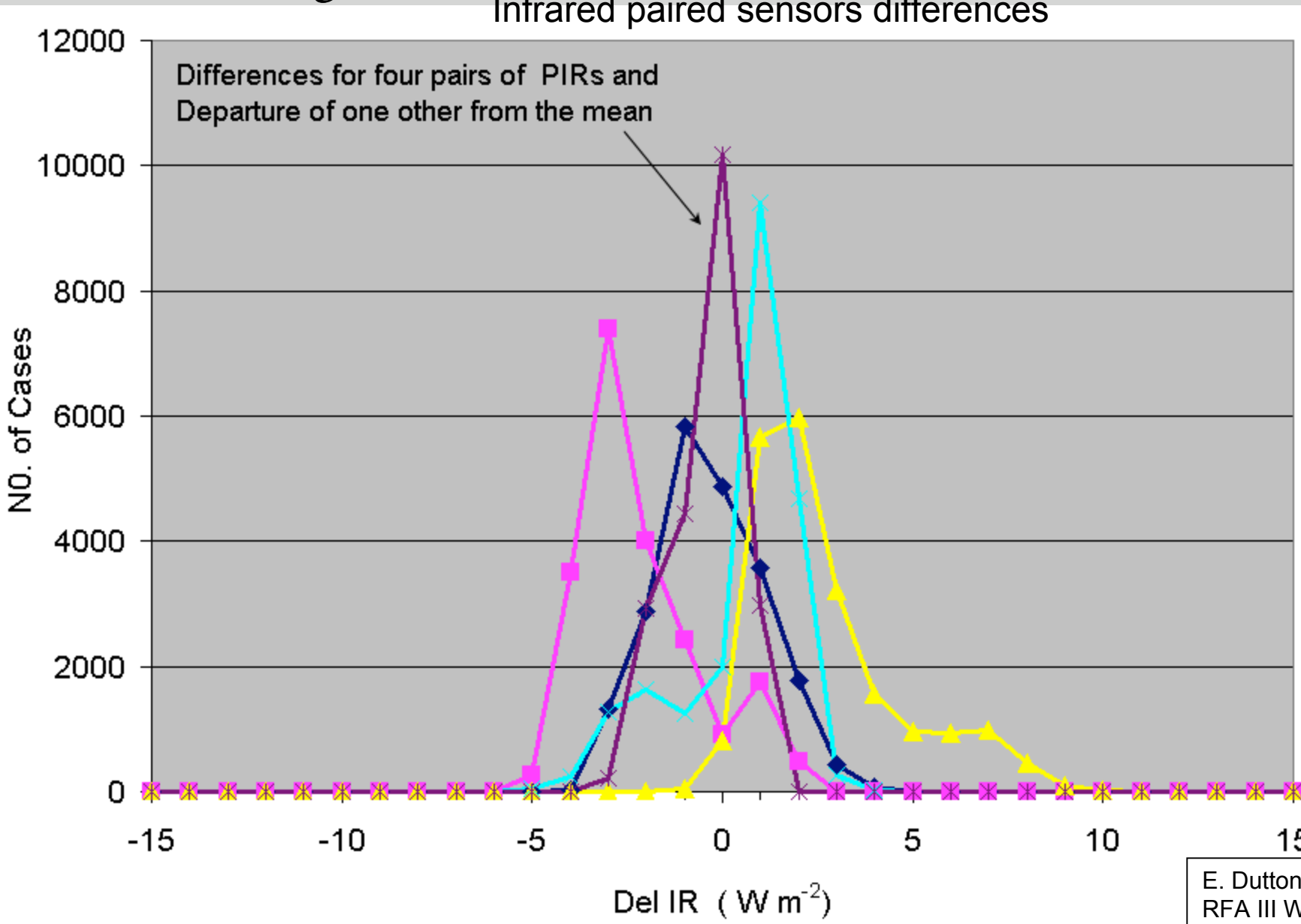


Dutton and Long



E. Dutton
RFA III W/S
25-27 June 07
New York

Dutton and Long



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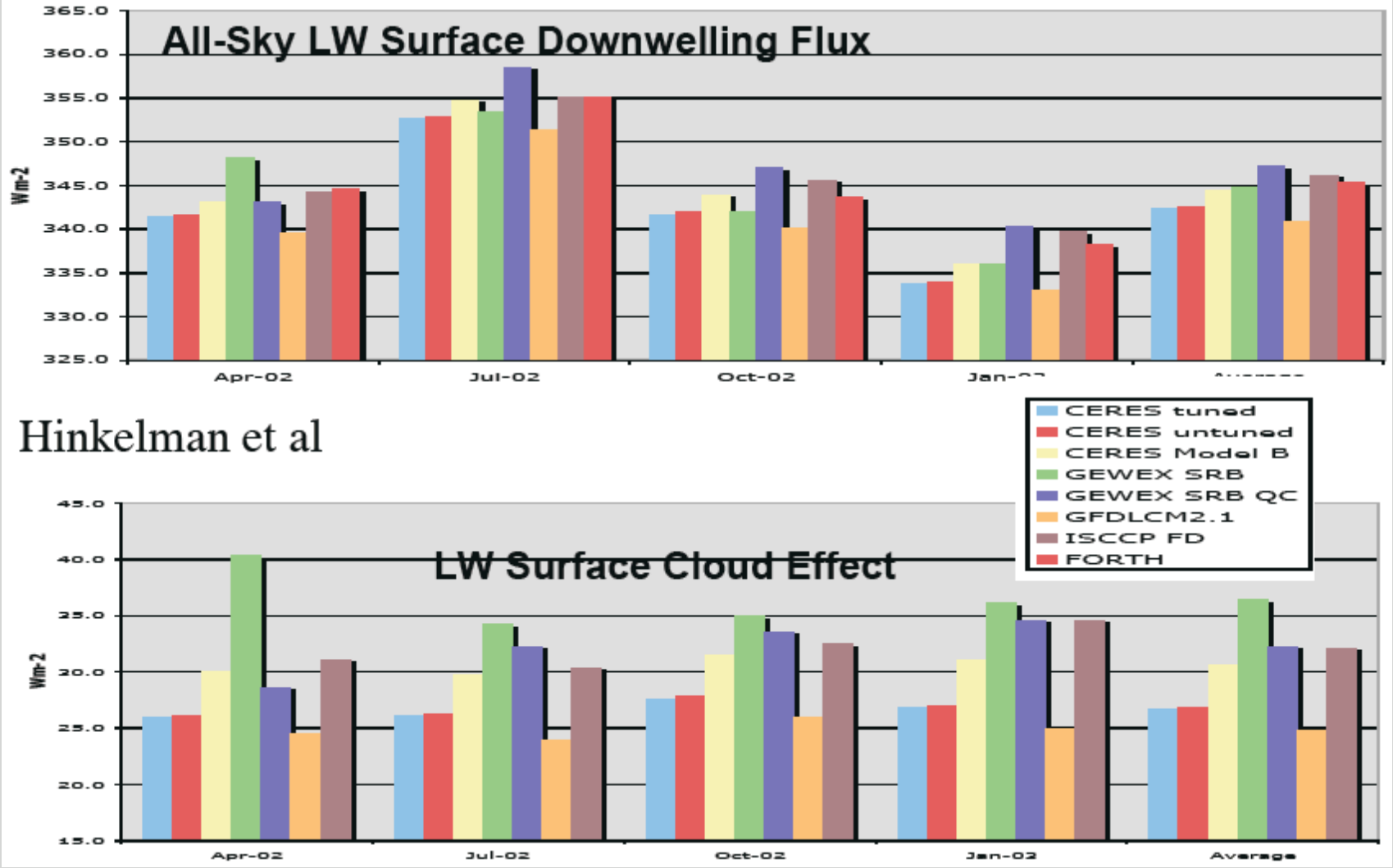
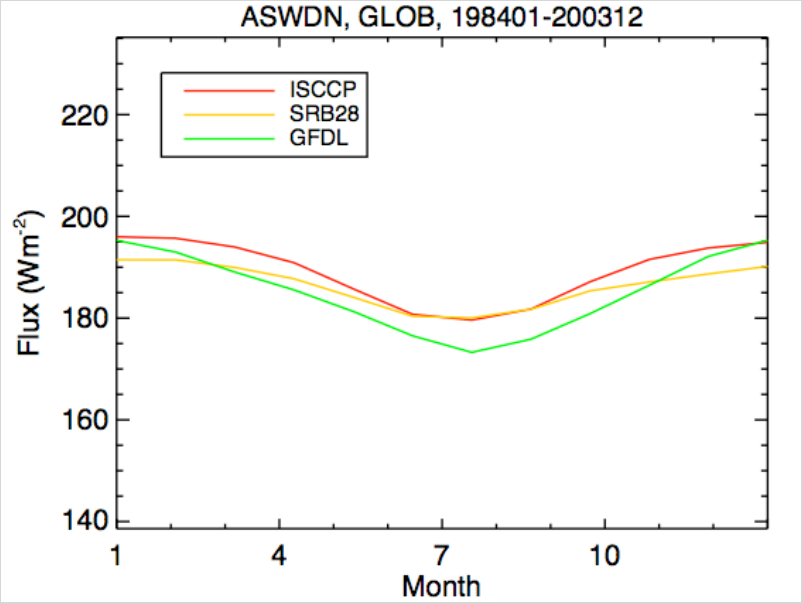
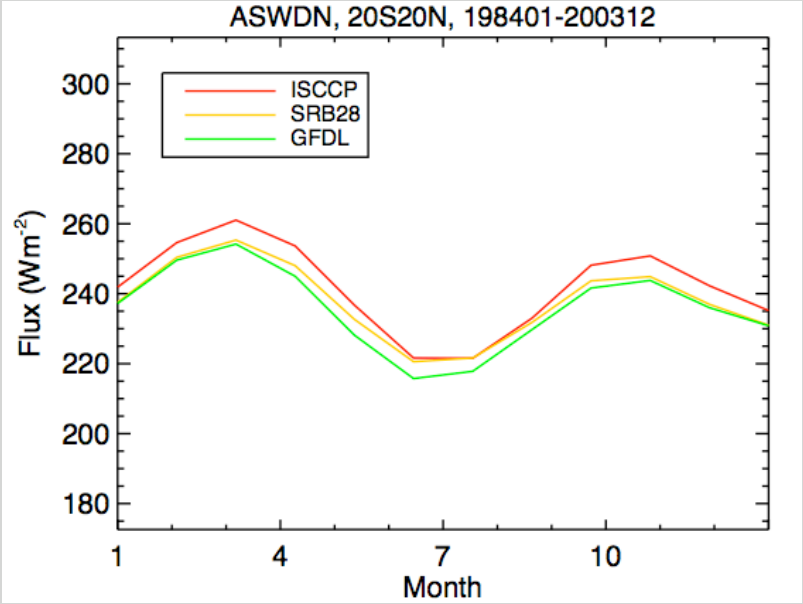
NASA

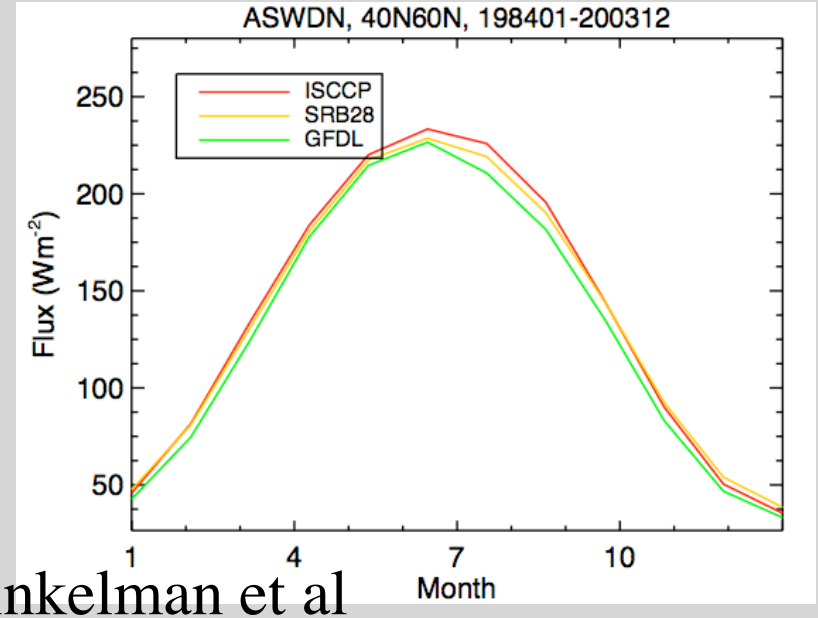
Multi-data Set Comparisons

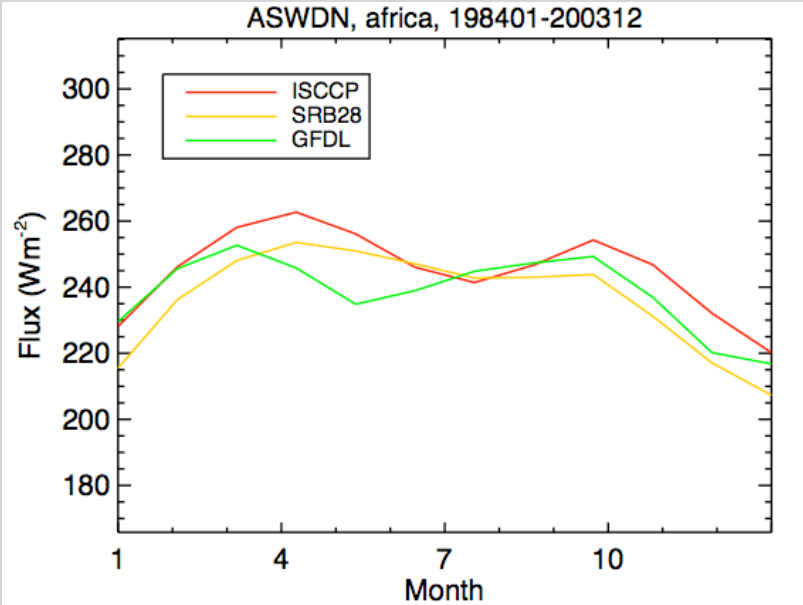


Seasonal Cycle Comparisons





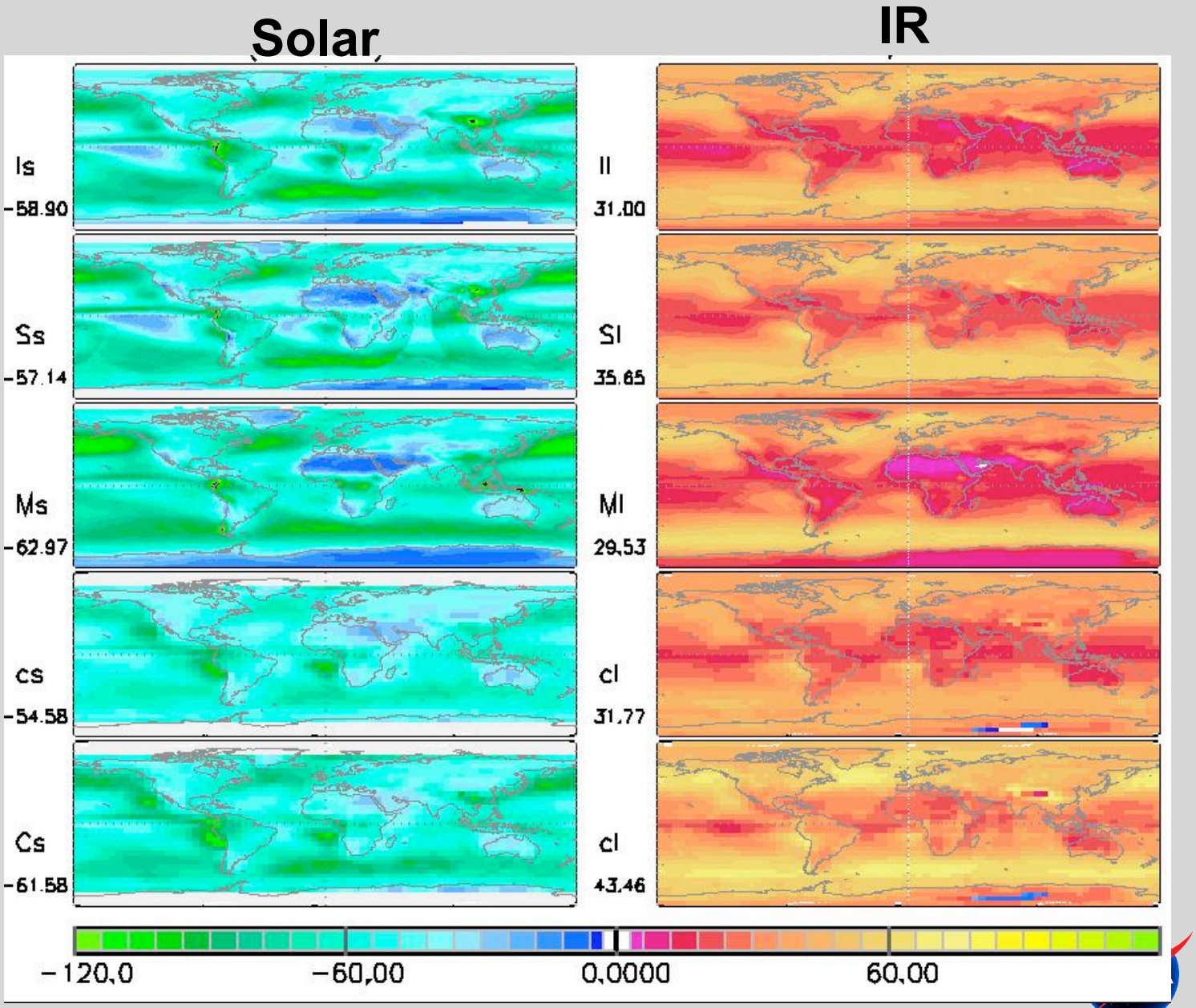




Hinkelman et al

Cloud Effect (CE) Comparisons

- ISCCP
- SRB
- IPCC
- off-line
- off-line
  - scaled



Kinne et al